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DOE/R4/20006--T35

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CONSULTING ENGINEER

MASTER

BRIEF RECONNAISSANCE STUDY
FOR THE
ADDITION OF HYDROPOWER

FOR

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COVER

MAYODAN DAM
MAYODAN, NORTH CAROLINA

SUBMITTED TO

REGION IV
U.S. DEPARTMENT OF ENERGY
ATLANTA, GEORGIA

SEPTEMBER 9, 1982

5819 Westmont Drive • Austin, Texas 78731 • 512-453-5577

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1.0 SUMMARY SHEET

PROJECT NO: DE-AC44-80R420006

DATE PREPARED: September 9, 1982

PROJECT TITLE: MAYODAN DAM

LOCATION: Mayodan, Rockingham County, North Carolina

PROJECT SPONSOR: Region IV, U.S. Department of Energy

DATE DAM WAS CONSTRUCTED: Approximately 1920

RECON REQUESTED BY/PROGRAM: Appalachian State University

EVALUATOR/AGENCY: T. G. Gebhard, Jr., P.E., Consultant to Region IV

POTENTIAL DEVELOPER: Washington Mills, Inc.

DAM OWNER: Washington Mills, Inc.

FINDINGS: THE DEVELOPMENT OF HYDROELECTRIC POWER AT THIS SITE APPEARS TO BE ECONOMICALLY FEASIBLE.

REMARKS: This site could be developed at the end of the existing canal or at a site adjacent to or in the mill. As less power could be developed at the end of the canal and as the development of hydroelectric power at the canal is economically feasible, then it appears logical to assume that the development of hydroelectric power near the mill would yield higher net benefits. Some information at this site had to be estimated, because the owner was not willing to provide it.

2.0 SITE DESCRIPTION

This section contains a description of the site location, the known flow characteristics, and the facilities and their condition.

2.1 SITE SUMMARY

Mayodan Dam impounds a small run-of-the-river reservoir near Mayodan, North Carolina, on the Mayo River, a tributary to the Dan River in the Roanoke River Basin. Until 1968, the dam diverted water into an adjacent canal, which conveyed water to a powerhouse downstream. The electricity generated at the dam was used by the textile mill downstream. Currently, the only use of the water is to provide fire protection to the mill, and some recreational fishing does occur at the dam.

2.2 HEAD AND DISCHARGE CHARACTERISTICS

The developable head at the dam is 14 feet. At the downstream end of the canal, the head is 20 feet to the rocky shoals below the structure. Another five feet of head can be obtained by removing the rock in the tail race. Apparently, a higher head exists at the mill, but the facilities at the mill were not accessible. Although a higher head can be developed, the easily developable head of 20 feet will be used in this study.

A U.S.G.S. gaging station, Mayo River near Price, N.C., was located upstream from the dam and collected streamflow records from August 1929 to October 1971. The drainage area at the gaging station was 260 sq. mi., and the drainage area at the dam is 322 sq. mi. Thus, records will have to be adjusted by a factor of 1.24. At the gage the peak discharge was 11,400 cfs; the minimum daily discharge was 35 cfs; and the average daily discharge was 312 cfs. The discharge equalled or exceeded 25 percent of the time was 340 cfs. An analysis of the flow duration data indicates that a plant factor of 69 percent is appropriate. For sizing the hydroelectric capacity of the site, the discharge equalled or exceeded 25 percent of the time at the dam is assumed to be 421 cfs.

2.3 SITE FACILITIES

Mayodan Dam is a masonry dam which has a concrete gravity overflow section. The dam is composed of a western abutment which extends into a railroad embankment, a diversion section with gates to control the flow into the canal, a 200 foot concrete overflow section, and an east abutment which extends into a rock outcrop. The dam is over a rocky shoals area which indicates a probable rock foundation. The dam appears to be in good condition.

The overflow section serves as the spillway for the dam and has an ogee shape. The surface of the spillway appears to be in good condition.

The diversion works appear to be in good condition with the exception of gates which need to be repaired or replaced. Two steel gates control the diversion of water into the canal, and five gates can be used to empty the canal. The canal appears to be in fair condition, as extensive amounts of brush need to be removed. At the end of the canal, a masonry structure exists to either divert water into a pipeline to the mill or to pass the water into the river. This structure appears to be in fair condition.

Although none of the mill's facilities could be inspected, the records of the Federal Energy Regulatory Commission indicate that a 600 kW hydroelectric generation facility existed at the mill.

The site is accessible, and the end of the canal is readily accessible by any method. Access to the dam for construction equipment would be difficult, although the adjacent railroad facilities could be used for access. The nearest electrical line is approximately one quarter of a mile from the end of the canal.

2.4 Site Sketch
Mayodan Dam
aerial view - not to scale

3.0 BUSINESS DATA

This section contains a description of the potential developer of the site and the potential use or customer for the power generated.

3.1 POTENTIAL DEVELOPER

The most probable developer is the owner, Washington Mills, Inc.

3.2 POTENTIAL CUSTOMER FOR POWER

Washington Mills purchases its power from Duke Power Company. The company did not provide any of the requested information on its costs of power. From other customers of Duke Power Company with a similar demand for electricity, it appears that the average cost of power is approximately 3.75 cents per kilowatt hour. If a hydroelectric facility was installed at the end of the canal, the company could use the power in its own operations and reduce its purchases from Duke Power Company.

4.0 ENVIRONMENTAL, INSTITUTIONAL, AND SAFETY DATA

This section contains environmental, institutional, and safety data in a format similar to that used in the loan application for a feasibility study.

4.1 ENVIRONMENTAL DATA

- 4.1.1 Is river or stream classified or under consideration for wild and/or scenic river status?

No. The Mayo River is not a Wild or Scenic River and is not listed as a potential site by the Southeastern Region of the U.S. Heritage Conservation and Recreation Service.

- 4.1.2 Is the proposed site located in a wildlife preserve, recreational area, national or state park, historical site, or in any other restricted-activity area (including those restricted under federal, state, or local law for future developments)?

No. The dam is not on the National Register of Historic Places and is not in any known restricted activity area.

- 4.1.3 Is the proposed site located nearby or adjacent to designated wilderness areas or at areas otherwise restricted from development under federal, state, or local law?

No.

- 4.1.4 Are any rare and endangered species located in the vicinity of the proposed development?

No. The U.S. Fish and Wildlife Service lists no endangered species for Rockingham County.

- 4.1.5 Are any migratory fish present in the river or stream during any part of the year?

No. The North Carolina Wildlife Resources Commission has no current concern on migratory fish in this stream segment. However, the commission staff has expressed a concern for minimum streamflow requirements if the flow of the river is to be diverted into the canal. The commission staff should be consulted during the early stages of any planning process to determine any requirements for minimum streamflow requirements, intake location, and fish passage.

4.2 INSTITUTIONAL DATA

- 4.2.1 Will the proposed hydropower installation alter the current dam usage and flows?

Yes. A hydropower unit should be placed on the downstream end of the canal or adjacent to the mill building. This would divert a major portion of the water from the stream.

- 4.2.2 Identify the owner of the dam and support facilities.

The owner of the dam is Washington Mills, Inc.

Box Y

Mayodan, NC 27027.

The contact is Mr. Bill Morehead

919-427-5131.

- 4.2.3 Does the proposer have right of access and the right to develop the project site and acquired right of way for transmission by easement, ownership, long term (firm) lease agreement or condemnation?

Yes. The owner has title to all development rights.

4.3 SAFETY DATA

- 4.3.1. Does the proposed hydropower installation require modification to the existing dam structure?

No.

- 4.3.2 Last date the dam was inspected and by what agency?

No known dam safety inspection has been made. There is no known Corps of Engineers Identification Number.

- 4.3.3 Has a dam safety report been issued, and what was the conclusion?

No known dam safety report has been issued.

5.0 PLANT CHARACTERISTICS AND POWER POTENTIAL

This section contains a description of the characteristics developed to determine the power generation potential of the site and to estimate the investment cost required to develop the site.

<u>ITEM</u>	<u>VALUE</u>	<u>INFORMATIONAL SOURCE</u>
Developable Head	20 Ft.	Site Visit
Flow Equalled or Exceeded 25% of Time	421 cfs	U.S.G.S. Records
Capacity (Based on 85% Efficiency)	615 kW	Calculation
Average Yearly Energy Produced (Based on 69% Plant Factor)	3,715,000 kWhr	Calculation
Tailrace Length	100 Ft.	Site Visit
Penstock Length	0 Ft.	Site Visit
Transmission Line Length	0.25 Mi.	Site Visit
Economic Life	30 Years	

ASSUMPTIONS: The estimate of the flow is based on the records of an abandoned U.S.G.S. gaging station which was upstream from the dam. The head is based on the development of the head which exists at the base of the structure at the end of the canal.

6.0 PROJECT ECONOMICS

This section contains the calculations of the costs and the benefits for developing hydroelectric power at this site and develops benefit cost ratios for two discount rates.

6.1 INVESTMENT COSTS

<u>ITEMS</u>	<u>JULY 1978 PRICE</u>	<u>SOURCE</u>
Turbine, Generator, and Civil Works	\$800,000	*Fig. 4-2, Vol.I
Switchyard Equipment	54,000	**Fig. 5-39
Transmission Line	7,500	*Table 4-2, Vol. I
Civil Works Rehabilitation	<u>200,000</u>	Evaluator's Estimate
SUBTOTAL	1,061,500	
Contingencies (10%)	<u>106,150</u>	
SUBTOTAL	1,167,650	
Indirect Costs (25%)	<u>291,900</u>	
	1,459,550	
ADJUSTMENT TO JANUARY 1982 PRICES (2.85/2.28 = 1.25)	\$1,824,400	*Fig. 6-1(b), Vol. VI
ADJUSTMENT FOR REGIONAL COSTS (0.85)	\$1,551,000	*Fig. 6-2, Vol.VI
<u>TOTAL INVESTMENT COST</u> =	\$1,551,000	

*U.S. Army Corps of Engineers, Feasibility Studies for Small Scale Hydropower Additions - A Guide Manual, The Hydrologic Engineering Center, July 1979.

**Tudor Engineering Company, Reconnaissance Evaluation of Small, Low Head Hydroelectric Installations, Water and Power Resource Service, U.S. Department of Interior, July 1980.

6.2 OPERATING AND MAINTENANCE COSTS

O & M costs are estimated to be \$13,000. This estimate is based on Fig. 2.1 of Reconnaissance Evaluation of Small, Low Head Hydroelectric Installations by Tudor Engineering for the U.S. Bureau of Reclamation.

6.3 ESTIMATE OF BENEFITS

Benefits are based on the value of 3,832,000 kWhr at 3.75 cents per kilowatt hour.

$$3,715,000 \text{ kWhr} \times \$0.0375/\text{kWhr} = \$139,300.$$

6.4 ECONOMIC EVALUATIONS

Investment Costs	\$1,551,000
First Year Annual Revenue	\$ 139,300
Escalation Rate of Revenues	8 %
First Year O & M Costs	\$ 13,000
Escalation Rate for Expenses	6 %
Number of Years	30 Years
Benefit Cost Ratio for 9% Discount Rate	2.18
Benefit Cost Ratio for 16% Discount Rate	0.99

7.0 PHOTOGRAPHS

DAM AND SPILLWAY

WESTERN END OF DAM

DIVERSION WORKS

GATE STRUCTURE

DOWNSTREAM END OF CANAL

AREA BELOW CANAL

APPENDIX

VICINITY MAP

DURATION TABLE OF DAILY VALUES FOR YEAR ENDING SEPTEMBER 30

NEAR
NATO RIVER NEAR PRICE, N. C.

CLASS	VALUE	TOTAL	ACCUM	PERCT	CLASS	VALUE	TOTAL	ACCUM	PERCT	CLASS	VALUE	TOTAL	ACCUM	PERCT
0	0.0	0	15340	100.0	12	240.0	1722	7409	46.3	24	1900.0	43	138	0.8
1	35.0	7	15340	100.0	13	240.0	1774	5607	37.1	25	2300.0	30	65	0.6
2	1.0	26	15353	100.0	14	380.0	1204	3713	34.2	26	2700.0	11	95	0.5
3	1.0	33	15307	99.6	15	63.0	99.7	14.9	1.5	27	3200.0	19	48	0.3
4	59.0	62	15274	99.6	16	480.0	551	1672	10.9	28	3600.0	9	29	0.1
5	76.0	154	15212	99.2	17	570.0	293	1121	7.3	29	4600.0	3	20	0.1
6	672	89	15054	99.2	18	670.0	253	5.4	0.3	30	4900.0	0	17	0.1
7	99.0	673	14766	96.4	19	800.0	130	57.5	3.7	31	4500.0	2	9	0.0
8	126.0	931	14113	92.0	20	950.0	95	445	2.9	32	7700.0	4	7	0.0
9	140.0	1800	13182	85.9	21	1100.0	117	350	2.3	33	9200.0	2	3	0.0
10	176.0	1001	11382	79.0	22	1400.0	90	1.5	0.1	34	11000.0	1	1	0.0
11	200.0	2172	9581	62.8	23	1600.0	45	183	1.2					

VALUE EXCEEDED 'P' PERCENT OF TIME

V95 =	110.0
V96 =	110.0
V75 =	170.0
V70 =	180.0
V50 =	240.0
V25 =	340.0
V10 =	500.0